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GB00/1162

REC'D 19 APR 2000	
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29MAR99 E436158-1 D00180  
P01/7700 0.00 - 9907116.9

# Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office

Cardiff Road  
Newport  
Gwent NP9 1RH

1. Your reference

NG/

2. Patent application number

(The Patent Office will fill in this part)

**9907116.9**

3. Full name, address and postcode of the or of each applicant (underline all surnames)

SMITH INTERNATIONAL, INC.  
16740 Hardy Street,  
Houston,  
Texas 77205-0068,  
U.S.A.

Patents ADP number (if you know it)

If the applicant is a corporate body, give the country/state of its incorporation

(A Delaware Corporation) U.S.A.

00725358002.

4. Title of the invention

WHIPSTOCK CASING MILLING SYSTEM

5. Name of your agent (if you have one)

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

A.A. THORNTON & CO.,

Northumberland House,  
303-306 High Holborn,  
LONDON  
WC1V 7LE

Patents ADP number (if you know it)

75001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number  
(if you know it)

Date of filing  
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing  
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

See note (d))

# Patents Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form

Description

4

Claim(s)

-

Abstract

-

Drawing(s)

2 + 2

10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (Patents Form 7/77)

Request for preliminary examination and search (Patents Form 9/77)

Request for substantive examination (Patents Form 10/77)

Any other documents (please specify)

11. I/We request the grant of a patent on the basis of this application.



Signature

Date  
26 March 1999

12. Name and daytime telephone number of person to contact in the United Kingdom NIGEL GOODENOUGH - 01604 638242

## Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

## Notes

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## WHIPSTOCK CASING MILLING SYSTEM

This invention relates to a whipstock casing milling system, and more particularly to such a system in which a window mill is secured to the whipstock so that the system may be run into a well, set and operated to open a window in the casing in a single trip.

A one trip casing milling system as described above is shown in our British patent publication GB2312702A. In the system described in this patent specification a window mill is secured by means of a sheet bolt to the end of the whipstock. The window mill includes a tapered end the taper of which matches the ramp angle of the end portion of the whipstock. This ramp angle is relatively steep (typically  $15^{\circ}$ ) so that at the start of casing milling the window mill is forced rapidly into the casing in order to form an initial opening.

Whilst this system for effecting the initial break through of the casing offers considerable advantages over the prior art, the arrangement does have the disadvantage that the area of contact between the tapered portion of the window mill and the initial steep ramp surface on the whipstock decreases as the window mill begins to penetrate the casing. Although the whipstock ramp continues to apply a lateral force to the window mill the reaction force on the whipstock becomes progressively concentrated on a small region of the ramp face. Even though the whipstock ramp may be hardened the fact that the reaction force from the window mill is concentrated on a relatively small area of the ramp tends to lead to wear of the ramp. This wear is particularly noticeable at the point where there is a change of whipstock angle at the bottom end of the initial steep ramp portion. Immediately before the casing milling tool begins to run down the relatively shallow angled (or parallel) portion of the whipstock below the steep ramp, the entire reaction force applied by the window mill to the whipstock is concentrated in this small area. Even if the

whipstock is extensively hardened in this area wear will inevitably occur. One result of this wear is that the window in the casing is not opened up as quickly as might be expected from the initial (pre-wear) profile of the whipstock.

We have now devised a solution to this problem.

Accordingly, the present invention provides a whipstock casing milling system comprising: a whipstock having an upper end and a whip face, the whip face including an initial relatively steep ramp portion and a relatively shallow ramp portion or parallel portion immediately below the relatively steep ramp portion; a window mill secured to the whipstock adjacent the relatively steep ramp surface and operable in use to form an opening in a casing in which the whipstock casing milling system is located, the window mill being deflected by the relatively steep ramp surface laterally into the casing as the window mill is rotated and forced downwardly of the casing; and a protrusion provided on the relatively shallow or parallel portion of the whip face, the protrusion forming an extension of the relatively steep portion of the whip face to reduce damage to the relatively steep portion of the whip face at the juncture of the relatively steep portion and the relatively shallow portion during use of the tool.

The protrusion will, in practice, be milled partially or completely away during the casing milling operation. However, the existence of the protrusion prevents the excessive damage to the relatively steep portion of the ramp surface such as has occurred in the prior art. The protrusion may be of any suitable material, for example steel of a suitable grade or hard material such as tungsten carbide.

The invention will be better understood from the following description of a preferred embodiment thereof given by way of example only, reference being had to the accompanying drawings wherein

Figure 1 corresponds to Figure 4 of the above mentioned GB2313391A;

and

Figure 2 illustrates the improvement according to the present invention.

Turning firstly to Figure 1, there is shown a portion of the casing milling system of GB2313391A. Reference should be had to the text of this patent publication for further description of the illustrated system. For the present purposes however, it is sufficient to note that the illustrated system comprises a window mill 32 which is secured to a whipstock 44 by a sheer bolt 39. The whipstock has a whip face which includes a relatively steep starter surface 45 followed by a vertical surface 46 (i.e. a surface parallel to the longitudinal axis of the casing). The relatively steep starter surface 45 meets the vertical surface 46 at a transition point A. In use, after the illustrated casing milling system has been run in hole a packer secured to the bottom of the whipstock is set and the window mill 32 is released by sheering the shear bolt 39. The drill string is then rotated and weight applied to the window mill 32. The window mill runs up the relatively steep starter surface 45 on the whipstock and is thereby forced laterally into the casing on the side thereof opposite the whipstock. The casing is disintegrated and the starter mill moves downwardly.

It will be appreciated that immediately before the starter mill moves on to the vertical section 46 of the whipface the entire reaction force of the starter mill onto the whipface is taken by the portion of the starter surface 45 immediately adjacent the juncture A. This results in wear of the whipface at this point with the result that the starter mill is not forced cleanly through the casing as intended in the original design.

Referring now to Figure 2, the above outlined problem is solved by means of a protrusion B which is provided on the whipface immediately below the lower end of the starter surface 45. The protrusion B in effect extends the starter surface 45 downwardly of the well. The effect of the protrusion is to provide extra support for the reaction forces imposed on the whipface by the

window mill and thereby reduce or prevent the undesired wearing away of the starter surface 45 itself. In practice, the protrusion will in general be milled away in use by the window mill. However, the existence of the protrusion ensures that adequate lateral movement of the window mill is achieved before the window mill starts travelling down the vertical surface 46. The protrusion can be of any suitable material and can be secured to the whipface by any convenient means, for example by means of screws or by welding.

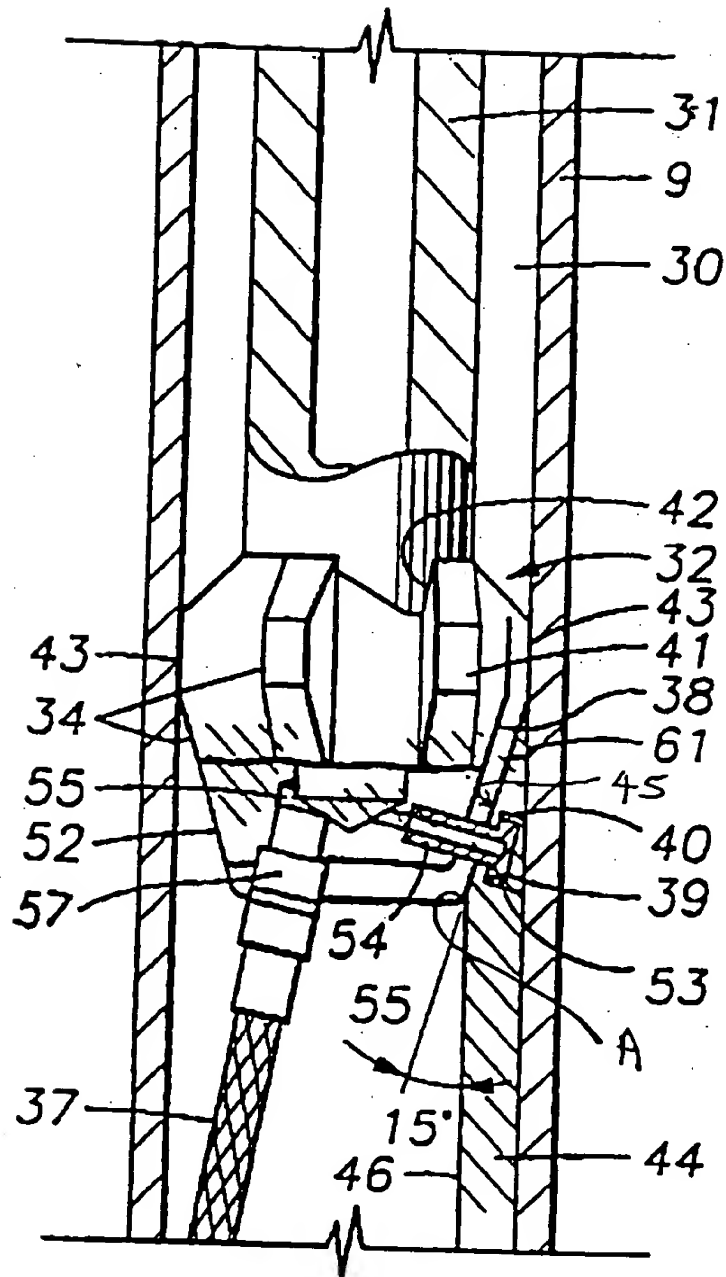
$$1/2$$


Fig 1



2/2

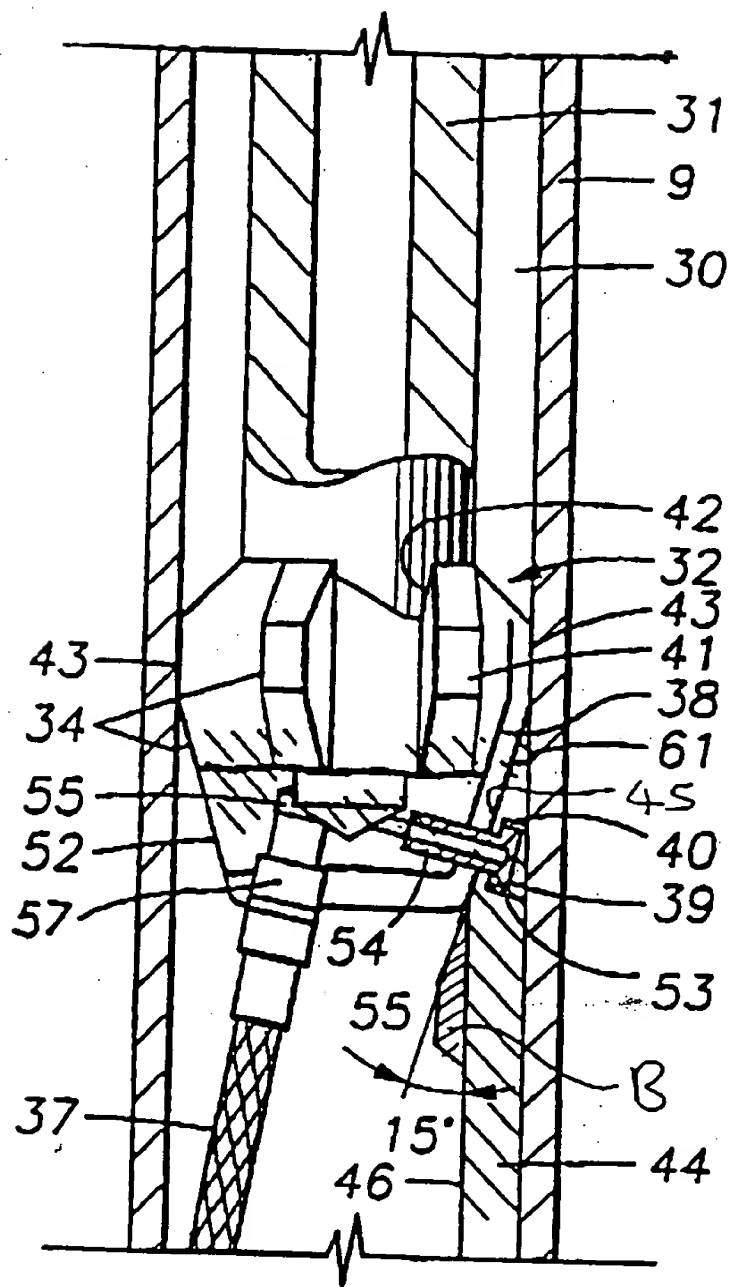


Fig 2